

# **YAESU**

## **G-450A**

## **G-650A**

### **Antenna Rotator & Controller**

### **User Manual**

#### **YAESU MUSEN CO., LTD.**

1-20-2 Shimomaruko, Ota-Ku, Tokyo 146-8649, Japan

#### **YAESU U.S.A.**

17210 Edwards Rd., Cerritos, CA 90703, U.S.A.

#### **YAESU EUROPE B.V.**

Snipweg 3, 1118DN Schiphol, The Netherlands

#### **YAESU UK LTD.**

Unit 12, Sun Valley Business Park, Winnall Trading Estate  
Winchester, Hampshire, SO23 0LB, U.K.

#### **YAESU GERMANY GmbH**

Am Kronberger Hang 2, D-65824 Schwalbach, Germany

#### **YAESU HK LTD.**

11th Floor Tsim Sha Tsui Centre, 66 Mody Rd.,  
Tsim Sha Tsui East, Kowloon, Hong Kong

## Packing List (Check Before Installing Rotator)

<b>Rotor</b>	1
<b>Controller</b>	1
<b>U bolts</b>	2
<b>M8×16 Bolts</b>	4
<b>Hex. Nuts</b>	4
<b>Spring Washers</b>	8
<b>Flat Washers</b>	4
<b>7-pin Round Plug</b>	1 set
<b>6-pin Rectangular Plug</b>	1 set
<b>Rubber Boot</b>	1
<b>User Manual</b>	1

## Available Options

<b>GA-2500</b>	Shock Absorber Plate
<b>GS-680U</b>	Universal Bearing
<b>GS-050</b>	Thrust Bearing (50 mm mast)
<b>GS-065</b>	Thrust Bearing (65 mm mast)
<b>GC-038B</b>	Mast Clamp
<b>C-25MWP</b>	Control Cable (25 m)
<b>C-40MWP</b>	Control Cable (40 m)
<b>GL-33</b>	Mast Adjustment Plate

## Specifications

	<b>G-450A</b>	<b>G-650A</b>
<b>Rotation Torque</b>	600 kgf-cm (43 ft-lbs.)	
<b>Braking Torque</b>	3000 kgf-cm (217 ft-lbs.)	5000 kgf-cm (362 ft-lbs.)
<b>Maximum Vertical load</b>	Continuous load 100 kg or less (Instantaneous load 300 kg)	
<b>Mast Outside Diameter</b>	$\phi 32$ to $\phi 63$ (center protrudes by $\phi 48$ to $\phi 52$ )	
<b>Rotation Range</b>	$450^\circ$	
<b>360° Rotation Time</b>	63 seconds at 50 Hz, 51 seconds at 60 Hz	
<b>Braking Type</b>	Mechanical stopper	Mechanical and electrical stoppers
<b>Antenna K Coefficient</b>	100	180
<b>Wind Loading Area (Pole type)</b>	$0.5 \text{ m}^2 \times 0.5 \text{ m}$	
<b>(Tower type)</b>	$1 \text{ m}^2$	$2 \text{ m}^2$
<b>Maximum Continuous Duty</b>	3 minutes	
<b>Operating Temperature Range</b>	0 ~ 40 °C: Controller	-20 ~ 40 °C: Rotor
<b>Rotor Dimensions and Weight</b>	$\phi 186 \times 263$ , approx. 3.5 kg	
<b>Controller Dimensions and Weight</b>	190 (W) $\times$ 125 (H) $\times$ 150 (D), approx. 2.7 kg	
<b>Power Supply Voltage</b>	AC 100 ~ 120 V, 50 ~ 60 Hz	
<b>Power Supply Current Consumption</b>	0.5 A	

## Installation/Operation Precautions

- Always use (Metric) M8x16 bolts when mounting the rotor to the tower or roof tripod mounting plate.
- Take care not to scratch the surface of the rotator or its mounting hardware. If the protective coating is scratched, the underlying metal may be subject to corrosion or rusting.
- During operation, do not suddenly reverse the rotation during operation, as this places a large load on the internal components of the rotor. Let the antenna come to a complete stop before reversing the direction of rotation.
- Do not engage the rotor for more than three minutes of continuous rotation. While this rotor can operate for up to five minutes continuously, operation must thereafter be halted, and the motor must be allowed to cool for *at least* 15 minutes afterwards.
- This rotator is designed to provide centered rotation of a mast with an *outside diameter*\* of between 48 mm and 50 mm (1.89" to 1.97" O.D.). If it is necessary to use a mast of diameter less than 48 ~ 50 mm, nearly centered rotation can be achieved using the optional “GL-33” mast adjustment plate, per the illustrations below.

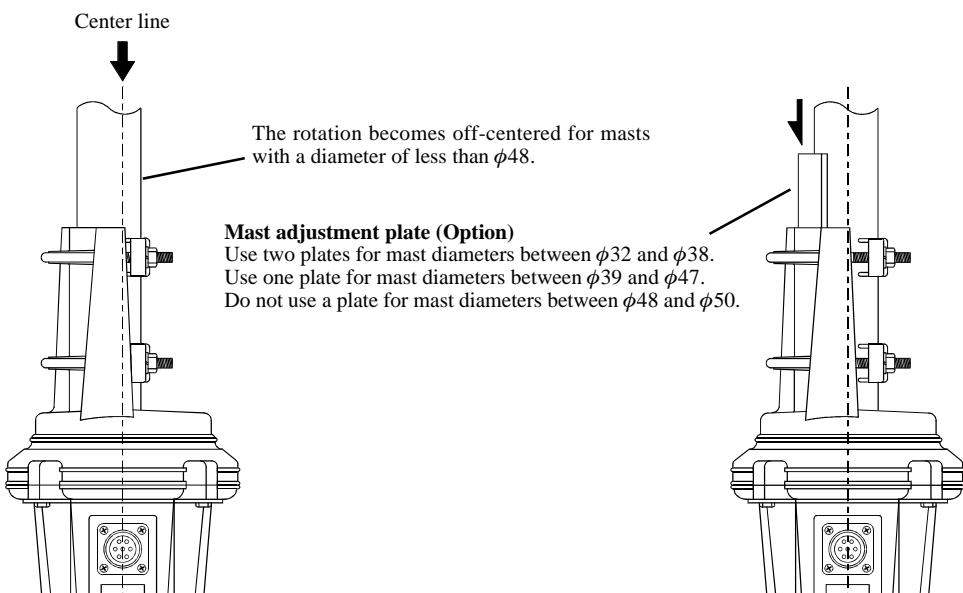
Mast Diameter  $\phi 32$  to  $\phi 38$ : Use two plates.

Mast Diameter  $\phi 39$  to  $\phi 47$ : Use one plate.

Mast Diameter  $\phi 48$  to  $\phi 50$ : Do not use a plate.

- The use of a mast of outside diameter greater than 51 mm (2.01") will result in off-center rotation. The amount of offset increases with increasing mast diameter. A mast of 60 mm outside diameter will result in rotation offset from the center by approximately 8 mm.

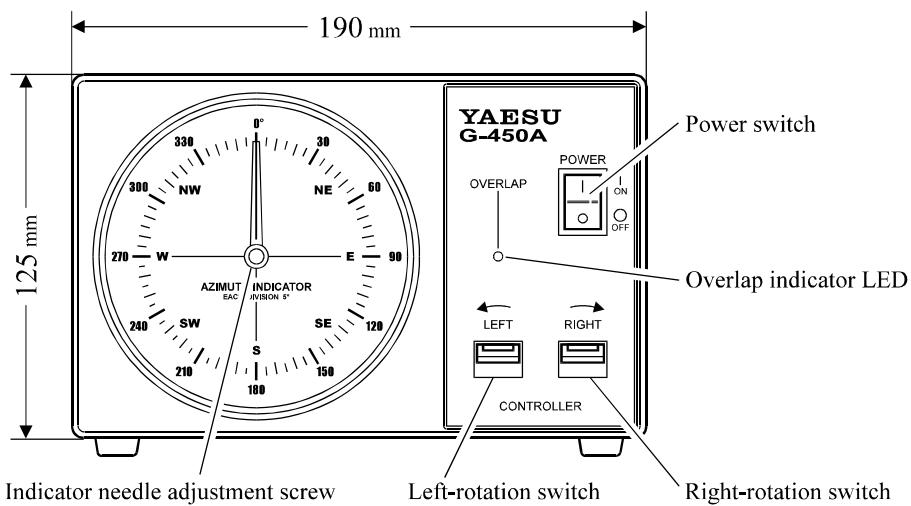
\* Note that commonly-available steel “water pipe” is (A) usually specified in terms of inside diameter, and (B) designed for holding in liquid under pressure; it is not particularly designed to resist bending. Consult with your dealer or a professional tower/antenna installer for assistance in procuring a mast of specifications adequate for your antenna system.



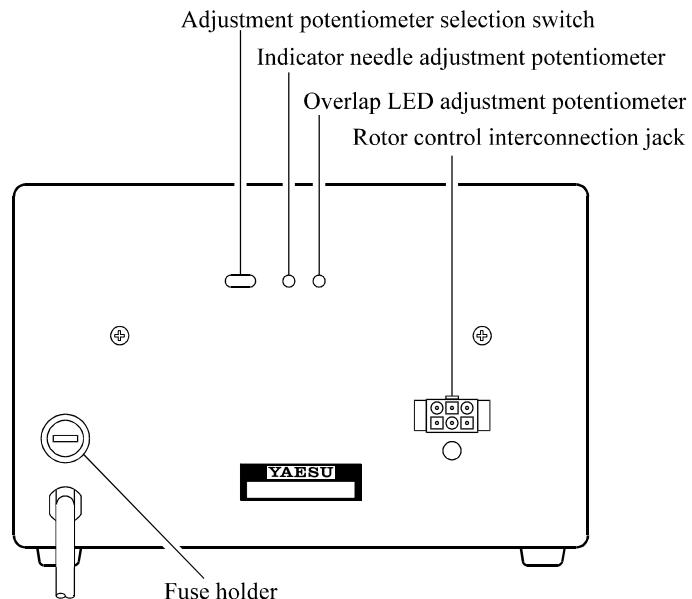
Insert the mast adjustment plate(s) between the mast and the clamps on the rotor.

# Controller Front/Rear Panel Controls and Switches

## Controller Front Panel

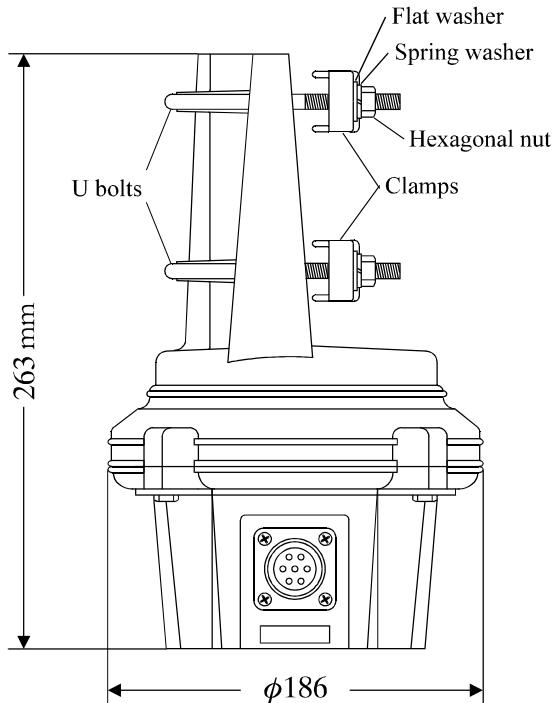


## Controller Rear Panel

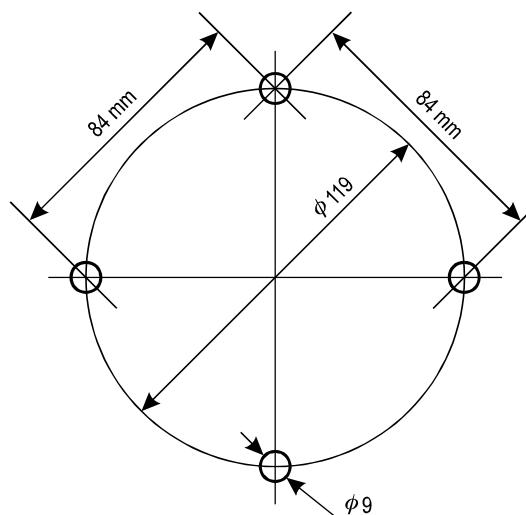


# Rotator Unit Components and Dimensions

## Rotator Unit



## Rotator Attachment Plate Dimensions



The tower plate onto which the rotator unit is mounted must be drilled with four holes of 9 mm diameter, equally spaced on a circle of 119 mm diameter. The center-to-center distance between any two adjacent mounting holes is 84 mm.

# Which Antennas Can Be Attached?

The size and type of antenna(s) that can be attached to this rotator will differ widely, depending on the installation method, local terrain, and the maximum expected wind speeds at your location.

The following pages describe typical antennas which are acceptable for installation with the G-450A or G-650A. The discussion below assumes maximum wind speeds of 30 meters per second (67 mph/108 kph), and it is recommended that you include a safety margin of at least 30% to account for higher wind gusts or other factors which might potentially cause damage to your installation.

## ● Pole-Mounted Antennas

Mounting of the rotator on a pole or mast results in a significant de-rating of the size of the antenna which can be mounted, due to the tremendous bending forces applied to the rotator's clamps. For pole mounting, the attached antenna must have a net mounted weight (combined weight of antenna *plus* mast) of **10 kg** or less, and the product of multiplying the [Antenna Wind Load Area (in  $m^2$ )] by the [Height of the Antenna Mast (in m)] must be **0.25** or less (see Table 1 and Fig. 1).

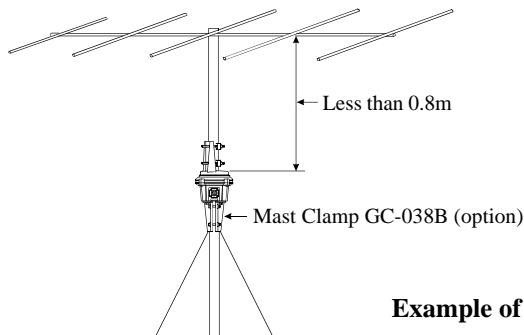
$$[\text{Antenna Weight}] + [\text{Mast Weight}] \leq 10 \text{ kg.}$$

$$[\text{Antenna Wind Load Area}] \times [\text{Height of Antenna Mast}] \leq 0.25$$

Refer to the antenna manufacturer's specification sheet for determining the weight and the surface area of the proposed antenna.

### Example

For a 50 MHz 5-element antenna of surface area of  $0.3 \text{ m}^2$  (see Table 1), the above specifications for pole mounting will be met if (A) the antenna is mounted on a mast not longer than 0.8 m ( $0.3 \times 0.8 = 0.24 < 0.25$ ), and (B) if the mast weight plus the antenna weight is less than 10 kg. However, if the mast is 1 meter long, the specification will be exceeded ( $0.3 \times 1 = 0.3 > 0.25$ ).



Example of a 50MHz Band, 5-Element Yagi Antenna

Table 1: Wind Loading Areas for Common Antennas (Typical)

Band (MHz)	Elements	Area ( $m^2$ )	Band (MHz)	Elements	Area ( $m^2$ )	Band (MHz)	Elements	Area ( $m^2$ )
7	2-element	2.2	28	3-element	0.3	50	4-element	0.25
7	1-element, w/loading coils	0.2	28	4-element	0.42	50	5-element	0.3
7	2-element, w/loading coils	0.6	28	5-element	0.6	50	6-element	0.37
7	3-element, w/loading coils	1.1	28	2-element, Swiss Quad	0.3	50	2-element, Swiss Quad	0.3
14	3-element	0.7	7/14	3-element, trapped	0.5	144	10-element	0.2
14	4-element	1.2	7/14	4-element, trapped	0.8	144	10-element, stacked	0.44
14	5-element	1.7	14/21	3-element, trapped	0.4	144	10-element, x 4	0.95
21	3-element	0.45	14/21	4-element, trapped	0.5	144	10-element, x 4 x 2	2.0
21	4-element	0.6	21/28	3-element, trapped	0.3	430	12-element	0.06
21	5-element	0.8	21/28	4-element, trapped	0.4	430	12-element, stacked	0.12
21	6-element	1.3	14/21/28	3-element, trapped	0.4	430	12-element, x 4	0.3
21	2-element, Swiss Quad	0.3	14/21/28	4-element, trapped	0.5	430	12-element, x 4 x 2	0.6

These are approximate values; Wind Loading Area will vary significantly depending on element and boom diameters.

## ● Tower-Mounted Antennas

In the preferred tower-mounting configuration, the antenna Wind Loading Area must be less than **1 m<sup>2</sup>** (G-450A) or **2 m<sup>2</sup>** (G-650A), and the “**K**” factor (see below) must not exceed **100** (G-450A) or **180** (G-650A), where **K** = [Antenna Turning Radius (m)] x [Antenna + Mast Weight (kg)].

Refer to the antenna manufacturer’s specification sheet for determining the turning radius and weight of the antenna.

### Example

In this example, a 14 MHz 3-element Yagi of Turning Radius 7.5 m, Weight of 14 kg, and Surface area of 0.7 m<sup>2</sup> is proposed for tower mounting below a 3-element 21/28 MHz trapped Yagi of Turning Radius 3.5 m, Weight of 13 kg, and Surface Area of 0.3 m<sup>2</sup>. The mast weight is 5 kg.

*Note: In such “Christmas Tree” installations, compute the mast weight separately for each antenna, using the relative heights of the two antennas to apportion the mast weight*

The antenna system **K** factor, then, is the sum of the two antenna **K** factors:

**K<sup>1</sup>** = **K** factor of 14 MHz 3-element Yagi.

$$\mathbf{K^1 = \frac{\text{Turning Radius (7.5 m)} \times \text{Weight (14 kg + 2.5 kg)}}{2} = 123.75}$$

$$\begin{array}{c} | \\ \text{Antenna Weight} \end{array} \quad \begin{array}{c} | \\ \text{Mast Weight (5 kg} \div 2) \end{array}$$

**K<sup>2</sup>** = **K** factor of 21/28 MHz 3-element trapped Yagi.

$$\mathbf{K^2 = \frac{\text{Turning Radius (3.5 m)} \times \text{Weight (13 kg + 2.5 kg)}}{2} = 54.25}$$

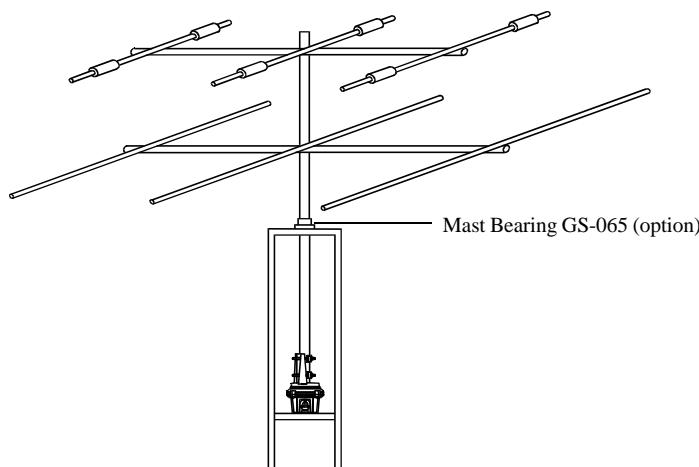
$$\begin{array}{c} | \\ \text{Antenna Weight} \end{array} \quad \begin{array}{c} | \\ \text{Mast Weight (5 kg} \div 2) \end{array}$$

$$\mathbf{K^{\text{Total}} = K^1 + K^2 = 123.75 + 54.25 = \underline{\underline{178}}}$$

The antenna system Wind Loading Area is:

$$0.7 \text{ m}^2 + 0.3 \text{ m}^2 = \underline{\underline{1.0 \text{ m}^2}}$$

The Wind Loading Area is within the specifications for both the G-450A and G-650A, but the net **K** factor (178) can only be met by the G-650A. Therefore, the above antenna system should only be mounted using a G-650A (or larger) rotator.



*Note: Installation of a Thrust Bearing such as the GS-065 does not allow the elimination of the mast weight from the **K**-factor calculations above.*

# Control Cable Installation

---

Before installing the rotator, mast, and antenna, prepare the rotator control cable and *test rotator system performance on the ground*. Potential alignment, cabling, or other problems can quickly be resolved on the ground; once a rotator is mounted, however, troubleshooting may require that the tower be climbed and/or the rotator be removed and lowered to the ground!

## Control Cable Preparation

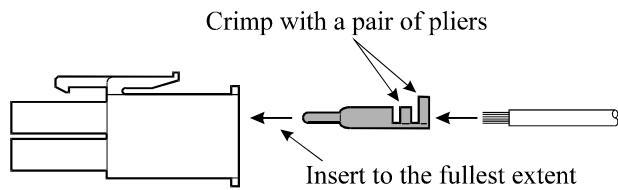
The control cable to be used should have six stranded conductors of at least 0.5 mm (#20 AWG) diameter if the cable is shorter than 40 m in length (125'); if the cable is longer than 40 m, use conductors with a diameter of 0.75 mm (#18 AWG) or larger.

1. Disassemble the supplied round plug: slide off the rubber boot, remove the setscrew from the shell using a small screwdriver, then unscrew the shell from the plug. Save the setscrew in a safe place until step 10, so you don't lose it.
2. Slide the rubber boot and the round shell over the "rotator" end of the cable. Leave enough cable protruding to allow easy dressing the end of the cable.
3. Using special care to avoid nicking the insulation of the individual wires, strip back 15 mm (about 5/8") of the outer jacket of the cable from both ends. Now strip 5 mm (about 3/16") of insulation from each wire, being careful not to nick the conductors.

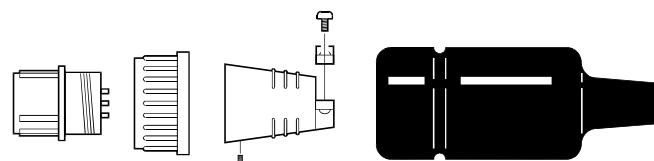


4. Solder the wires to the round plug pins, noting the color of the wire and the number associated with each pin for reference later. **Pin 7 of the round connector is not used!** Confirm that all solder joints are firm and cleanly made, as this part of the cable will be difficult to access once the rotator is installed on top of the tower. Do not slide the shell onto the connector at this time.
5. Crimp the supplied pin contacts onto the wires on the opposite end of the cable, per the illustration on the next page.
6. Referring to your notes of the wire color at each pin of the round (rotator end) connector, insert the pins into the rectangular plug at the opposite (controller) end of the cable. Be sure that each wire from the round connector is routed to the corresponding pin number in the rectangular connector (i.e. 1 to 1, 2 to 2, etc.).
7. Temporarily connect the round plug to the rotator, and the rectangular plug to the controller. Make sure that the **POWER** switch is set to the Off position, then connect the AC plug to your station's AC power outlet.
8. Turn on the **POWER** switch. The pilot lamps on the controller should become illuminated, and the meter needle on the controller may rotate so as to align itself with the current position of the rotator (remember, the two units have not been aligned with each other).
9. Press the **LEFT** (left rotation) switch, and confirm that the rotator (when viewed from the top) and the controller's needle turn counter-clockwise together. Stop rotation, then press the **RIGHT** (right rotation) switch, and confirm that the rotator and indicator needle turn clockwise. If rotation does not occur as indicated, turn the **POWER** switch off, and re-check your cable connections.
10. If the rotator and controller are working as described, replace the plug shells, setscrew, and rubber boot (removed in step 1).

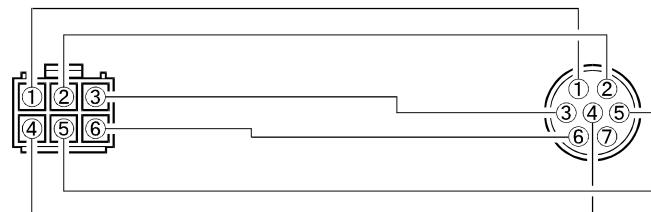
## Assembly of 6-pin Plastic Connector



## Assembly of 7-pin Metal Connector



## Wiring for the control cable (identical numbers to be integrated)



Pin No.7 for the metal connector is not used.

# Mounting the Rotator and Antenna

---

## ● Indoor Performance Check and Alignment

1. Temporarily connect the rotator unit and the controller using the connection cable prepared per the previous section.
2. Check to be sure that the **POWER** switch on the controller is set to **OFF**, then plug the controller's AC cable into your station's AC outlet.
3. Set the controller's **POWER** switch to **ON**. Verify that the controller's pilot lights have become illuminated.
4. Hold down the **LEFT** (Left rotation) switch, and continue to hold it down until the rotator reaches the counter-clockwise position where it automatically stops ("Left" represents counter-clockwise rotation when the rotator is viewed from the top).
5. When the rotator has reached the left "Stop" position, release the **LEFT** switch, and check to see if the controller's indicator needle is pointing to  $0^\circ$  (**N**: North).  
*If the indicator needle is out of alignment, slightly loosen the needle adjustment screw (using a small Phillips screwdriver) on the face of the indicator, then turn the white needle adjustment knob so that the indicator needle points precisely to  $0^\circ$ .*
6. Just above the round connector jack on the rotator unit, you will observe two raised calibration marks (one each on the (rotating) bell and (fixed) base of the rotator). These two marks should be directly aligned with each other. If not, place a small piece of masking tape on the rotating bell and the fixed base of the rotator unit, and make a calibration mark on each piece of tape, so as to mark the current position of the bell relative to the base. This calibration mark will be used to verify the amount of rotation in the next step.
7. Hold down the **RIGHT** (Right rotation) switch, and continue rotating to the right until the calibration marks (from Step 6) are again precisely aligned. Now check the indicator needle, which should also have rotated fully  $360^\circ$  so as to be pointing exactly to  $0^\circ$ . *If the indicator needle is not pointing exactly to  $0^\circ$ , go to the rear panel of the controller, and set the Adjustment Potentiometer Selection Switch (see Figure 2) to the **right** position. Now use a small screwdriver to adjust the Indicator Needle Adjustment Potentiometer (Fig. 2) so that the indicator needle points exactly to  $0^\circ$ .*
8. After aligning the needle to  $0^\circ$ , set the Adjustment Potentiometer Selection Switch back to the **left** position.
9. Hold down the **RIGHT** switch again, and continue rotation to the right. You should observe the "OVERLAP" LED becoming illuminated as rotation passes the  $360^\circ$  point.  
*If the OVERLAP LED does not light up at the  $360^\circ$  position, the Overlap LED Adjustment Potentiometer may be used to align the illumination threshold to the  $360^\circ$  point.*
10. Check to verify that rotation automatically stops at approximately  $90^\circ$  (East; representing a total rotation range of  $450^\circ$  from the original starting point).
11. Press the **LEFT** and **RIGHT** rotation switches a few more times, verifying that rotation appears to be normal. If so, press the **LEFT** switch to return the rotator to the fully counter-clockwise ( $0^\circ$ ) position.
12. At this time, you must determine whether you wish to leave the "Left Stop" position at North, or whether you wish to set it to South (to allow uninterrupted rotation from southeast to northeast to northwest to southwest, for example). *If you wish to leave the "Stop" at North, the checkout process is complete. If you wish to set the "Stop" to South, again loosen the needle adjustment screw on the face of the controller, and rotate the needle to the "South" position. Be certain that the rotator is fully rotated to the "LEFT" position in either case.*
13. Turn the **POWER** switch **OFF**. This completes the ground-based testing of the rotator and controller.

**ADVICE**

The position of the "Left Stop" can be set to whatever position you like (North, South, East, or West). Just remember where you have set it, because the antenna must initially be aimed in the same direction when it is installed on the mast (see next section).

## ● Installation of Rotator and Antenna on Tower

The procedure for installing the rotator depends on the type of tower used. The following instructions are generally applicable to most guyed, crank-up, or roof towers.

1. Attach the rotator to the tower's rotator mounting plate, using the supplied M8X16 bolts and spring washers. It is recommended that the tips of the bolts be lightly dipped in lubricating grease, to ease disassembly in the future.
2. If a thrust bearing (such as the optional Yaesu model GS-065) is to be utilized, mount it on the top of the tower (see Figure 4) using the supplied hardware.
3. Using a "gin pole" or other raising fixture, insert the antenna mast through the bearing from above, and set the mast in the rotator's mast clamps. Do not tighten the mast clamps at this time; just secure the U-bolts to the point where the mast is held in place, but is allowed to rotate freely.
4. Partly tighten the thrust bearing's mast bolts, so as to center the mast in the thrust bearing. When you are satisfied that the mast is centered, back off slightly on each of the thrust bearing's mast bolts, and (if possible) lift the mast by a *very small amount* (approximately 5 mm or 3/16"), just enough to lift the bottom of the mast slightly off the top of the rotator. Now re-tighten the thrust bearing's mast bolts to secure the mast in place. This procedure takes all the weight of the mast and antennas off of the rotator; all weight is being carried by the thrust bearing. If no thrust bearing is used, the mast should be allowed to rest on the top of the rotator.
5. Verify that the mast rotates freely in the mast clamps, and that the mast is properly centered in the clamps. Now tighten the nuts on the U-bolts of the mast clamp.

**CAUTION** Do not over-tighten the nuts on the mast clamps. They should be tightened until the spring washer becomes flat, then tightened further by 1/2 to one turn maximum.

6. Install the rotator control cable's round plug into the jack on the side of the rotator's base, and tighten the connector ring to secure the connector. Slide the rubber boot over the connector; while putting a slight amount of inward pressure on the rubber boot, use electrical tape to secure the back end of the rubber boot to the cable. This slight inward pressure on the rubber boot will enhance the weatherproofing of the installation. Secure the control cable to the tower in several places, using electrical tape and/or UV-resistant cable ties.
7. Install the antenna(s) on the mast. Use a compass to align the forward end of the beam toward North (0°) *or whichever direction to which you set the "Left Stop" in Step 12 of the previous section.*

8. Provide sufficient slack in the coaxial cable such that the antenna can rotate over its full 450° range without putting *any* tension on the coax (see Figure 8). Secure the coax to the tower, using electrical tape and/or UV-resistant cable ties.

9. Installation is now complete. If you have scratched through the melamine coating of the rotator during installation, you may wish to apply several coats of clear acrylic spray to help protect the bare metal from corrosion.

After installation is complete, test the system by operating the rotator through the entire range of its rotation. It is helpful to do so with the help of an observer, so that rotation can be stopped if some obstruction, binding, or tension on the coaxial cable's turning loop should be encountered during the performance test.

### Installation Note

If using a roof tower with a long mast between the top of the tower and the antenna, the use of a "Guy Bearing" is highly recommended. The Yaesu GS-050 and GS-065 include guying "ears" which allow attachment of guy cables. As installing a guying system may cause the center-lines of the guy bearing and the rotator to become mis-aligned, be certain to check the roof tower attachment and guy cable alignment to ensure that the mast is straight.

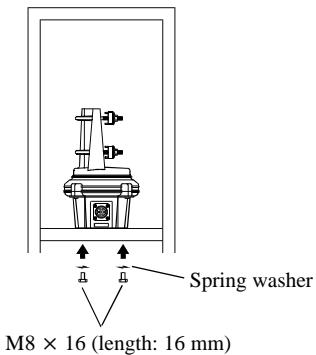


Figure 3

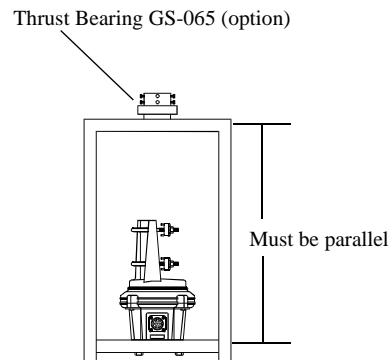


Figure 4

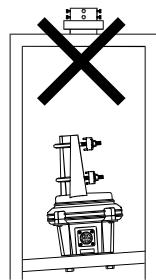


Figure 5

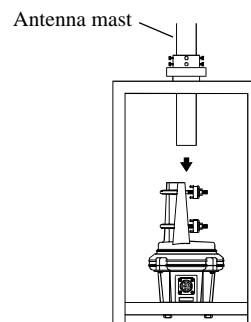


Figure 6

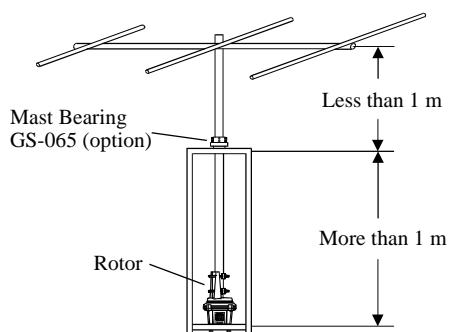


Figure 7

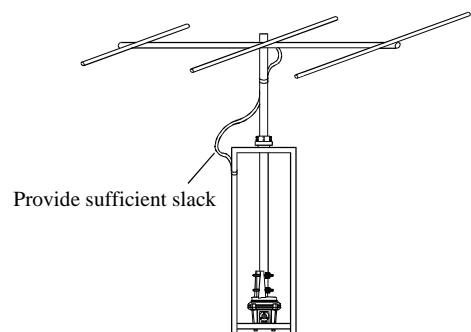


Figure 8

## ***Important!***

**The installation of a rotatable antenna on a tower system is a dangerous and potentially life-threatening task, if due care is not taken.**

**A tower must never be installed in a position where it could fall across power distribution cables in the event of a catastrophic tower failure during a windstorm or earthquake.**

**The control cable attached to this rotator could, in the event of a nearby or direct lightning strike, carry lethal voltages down the cable and into your home. Yaesu strongly recommends the installation of suitable lightning arrestors on all control cables and coaxial lead-in cables from your antenna installation. See your dealer for details of available lightning-protection devices.**

**If an electrical storm should be reported in your area, quickly unplug the control cable from the rear of the rotator's controller box, and disconnect the AC cable from the wall outlet. Disconnect the coaxial cable(s) from the antenna(s) as well. *Do this only if the lightning is not in your immediate area, as you could be killed instantly if lightning should strike while you are holding a cable.***

**If you have any doubts about your ability to install this rotator safely, enlist the services of a professional antenna installation company.**

Sq. Ft	M <sup>2</sup>	Sq. Ft	M <sup>2</sup>
1	0.093	12	1.115
2	0.186	13	1.208
3	0.279	14	1.301
4	0.372	15	1.396
5	0.465	16	1.486
6	0.557	17	1.579
7	0.650	18	1.672
8	0.743	19	1.765
9	0.836	20	1.858
10	0.929	21	1.951
11	1.022	22	2.044

**NOTE:**



**Copyright 1998  
Yaesu Musen Co., Ltd.  
All rights reserved.**

**No portion of this manual  
may be reproduced without  
the permission of  
Yaesu Musen Co., Ltd.**